CLAIMS

WHAT IS CLAIMED IS:

1. In a video signal processing system, a method of computing a motion decision value, which comprises the following steps:

inputting a video signal with an interlaced video sequence of fields;

comparing mutually corresponding fields and defining a point-wise non-recursive motion decision parameter indicating motion at a given point between a previous field and a next field in the video sequence;

computing a recursive motion decision parameter by combining the non-recursive motion decision parameter with a motion decision parameter of at least one associated previous field; and

outputting the recursive motion decision parameter for further processing in the video signal processing system.

2. The method according to claim 1, wherein the step of forming the point-wise motion decision parameter comprises computing

$$f_n(i,h) = l_K(d_n(i,h))$$

where $f_n(\cdot)$ is a point-wise motion detection signal, i and h define a spatial location of the respective video signal value in a cartesian matrix, and $l_K(\cdot)$ denotes a linearly scaling function.

3. The method according to claim 1, which comprises taking motion information of the associated previous fields into account in defining a current motion defined by the recursive motion decision parameter.

4. The method according to claim 3, wherein the recursive motion decision parameter $M_n(i,h)$ is in the form of

$$M_n(i,h) = F(m_n(i,h), M_{n-2}(i,h))$$

where $F(\cdot)$ represents a monotonous function with respect to $M_n(i,h)$ and $M_{n-2}(i,h)$ having imposed thereon the following condition:

$$\min(m_n(i,h), M_{n-2}(i,h)) \le F(m_n(i,h), M_{n-2}(i,h)) \le \max(m_n(i,h), M_{n-2}(i,h)).$$

5. The method according to claim 1, which comprises computing a non-recursive motion detection signal from the

point-wise motion detection parameter by an equation selected from the group consisting of

$$\phi_n(i,h) = f_n(i,h) + \min(f_{n-1}(i-1,h), f_{n-1}(i+1,h))$$

$$\phi_n(i,h) = med(f_n(i,h), f_{n-1}(i-1,h), f_{n-1}(i+1,h))$$

$$\phi_n(i,h) = \max(f_n(i,h), f_{n-1}(i-1,h), f_{n-1}(i+1,h))$$

where $f_{n-1}(\cdot)$ denotes a motion detection signal delayed by one field, $med(\cdot)$ denotes a median operation, $max(\cdot)$ denotes an operation to minimize an error from a false motion detection, and the indices i and h define a spatial location of the respective video signal value in a cartesian matrix.

6. In a method of processing interlaced video signals, which comprises:

spatially interpolating a value of the video signal at a given location from a video signal of at least one adjacent location in a given video field;

temporally interpolating the value of the video signal at the given location from a video signal at the same location in temporally adjacent video fields; and

forming a recursive motion decision value for the same location in accordance with claim 1; and

mixing an output signal for the video signal at the given location from the spatially interpolated signal and the temporally interpolated signal and weighting the output signal in accordance with the recursive motion decision value.

7. The method according to claim 6, which comprises varying the motion decision value between 0 and 1 as a function of an estimate of the degree of motion at the given location and, upon estimating a high degree of motion, heavily weighting the output signal towards the spatially interpolated signal and, upon estimating a low degree of motion, heavily weighting the output signal towards the temporally interpolated signal.

8. The method according to claim 6, which comprises outputting the spatially interpolated signal as the output signal upon estimating a high degree of motion, and outputting the temporally interpolated signal as the output signal upon estimating a low degree of motion.

9. In a video signal processing system, an apparatus for computing a motion decision value, comprising:

an input for receiving a video signal with an interlaced video sequence of successive fields;

a non-recursive motion detection unit connected to receive the video signal and to compute and output a non-recursive motion decision parameter defining a motion difference between a previous field and a next field of a current field to be deinterlaced;

a recursive motion detection unit connected to receive the non-recursive motion decision parameter and configured to compute a recursive motion decision parameter by combining the non-recursive motion decision parameter with a motion decision parameter of at least one associated previous field.

10. The apparatus according to claim 9, wherein said recursive motion detection unit is configured to take into account motion information of the associated previous fields in defining a current motion defined by the recursive motion decision parameter.

11. The apparatus according to claim 10, wherein the recursive motion decision parameter $M_n(i,h)$ is in the form of

$$M_n(i,h) = F(m_n(i,h), M_{n-2}(i,h))$$

where $F(\cdot)$ represents a monotonous function with respect to $M_n(i,h)$ and $M_{n-2}(i,h)$ having imposed thereon the following condition:

$$\min(m_n(i,h), M_{n-2}(i,h)) \le F(m_n(i,h), M_{n-2}(i,h)) \le \max(m_n(i,h), M_{n-2}(i,h)).$$

12. The apparatus according to claim 9, wherein said non-recursive motion detection unit is programmed to form from respectively associated fields of the video signal a point-wise motion decision parameter in accordance with

$$f_n(i,h) = l_K(d_n(i,h))$$

where $f_n(\cdot)$ is a point-wise motion detection signal, i and h define a spatial location of the respective video signal value in a cartesian matrix, and $l_K(\cdot)$ denotes a linearly scaling function.

13. The apparatus according to claim 12, wherein said non-recursive motion detection unit is programmed to compute a non-recursive motion detection signal from the point-wise motion detection parameter by an equation selected from the group consisting of

$$\phi_n(i,h) = f_n(i,h) + \min(f_{n-1}(i-1,h), f_{n-1}(i+1,h))$$

$$\phi_n(i,h) = med(f_n(i,h), f_{n-1}(i-1,h), f_{n-1}(i+1,h))$$

$$\phi_n(i,h) = \max(f_n(i,h), f_{n-1}(i-1,h), f_{n-1}(i+1,h))$$

where $f_{n-1}(\cdot)$ denotes a motion detection signal delayed by one field, $med(\cdot)$ denotes a median operation, $max(\cdot)$ denotes an operation to minimize an error from a false motion detection, and the indices i and h define a spatial location of the respective video signal value in a cartesian matrix.

14. The apparatus according to claim 9, which further comprises a low-pass filter connected to an output of said recursive motion detection unit.

15. The apparatus according to claim 14, wherein said low-pass filter is configured to filter a signal carrying the recursive motion decision parameter to form the motion decision value $m_n(i,h)$ by:

$$m_n(i,h) = \sum_{p=-a}^{b} \sum_{q=-c}^{d} \phi_n(i+2\times p, h+2\times q)\cdot \alpha_{p,q}$$

where a,b,c,d ≥ 0, and $\alpha_{p,q}$ represents a set of normalized predetermined coefficients of said low pass filter.

16. An apparatus for processing interlaced video signals, which comprises:

an input for receiving a video signal with an interlaced video sequence of fields;

a spatial interpolator connected to said input and configured to spatially interpolate a value of the video signal at a given location from a video signal of at least one adjacent location in a given video field;

a temporal interpolator connected to said input in parallel with said spatial interpolator for temporally interpolating the value of the video signal at the given location from a video signal at the same location in temporally adjacent video fields; and

an apparatus according to claim 9 connected to said input and in parallel with said spatial interpolator and said temporal interpolator for forming a motion decision value for the same location; and

a mixer connected to receive an output signal from each of said spatial interpolator, said temporal interpolator, and said computing apparatus, said mixer being configured to mix an output signal for the video signal at the given location from the spatially interpolated signal and the temporally interpolated signal in dependence on the recursive motion decision value output by said apparatus according to claim 9.